



S/C Bus Cost Summary/Reductions

August 15-16, 2001



Summary

Subsystem	WBS	CSR	Jun-01	Remove 8 mo	Schedule Savings	8/14/01	Additional Savings
SC PM	5.1	\$ 940,483	\$ 1,465,733	\$ 1,233,861	\$ 231,872	\$ 1,233,861	\$ -
FLT HW	5.2	\$ 31,863,692	\$ 45,571,032	\$ 43,178,720	\$ 2,392,312	\$ 36,938,701	\$ 6,240,019
ACS	5.2.1	\$ 4,125,758	\$ 5,231,966	\$ 4,945,021	\$ 286,945	\$ 4,698,446	\$ 246,575
RCS	5.2.2	\$ 4,644,637	\$ 6,179,295	\$ 5,906,199	\$ 273,096	\$ 4,235,650	\$ 1,670,549
EPS	5.2.3	\$ 5,388,224	\$ 7,680,811	\$ 7,236,758	\$ 444,053	\$ 5,984,432	\$ 1,252,326
CTDH	5.2.4	\$ 3,731,383	\$ 5,750,009	\$ 5,554,475	\$ 195,534	\$ 4,979,015	\$ 575,460
STRUC	5.2.5	\$ 4,210,353	\$ 3,828,857	\$ 3,598,067	\$ 230,790	\$ 2,989,361	\$ 608,706
THERMAL	5.2.6	\$ 1,399,988	\$ 2,332,712	\$ 2,165,795	\$ 166,917	\$ 1,652,484	\$ 513,311
RF	5.2.7	\$ 3,601,586	\$ 4,123,446	\$ 3,891,767	\$ 231,679	\$ 3,443,316	\$ 448,451
FLT SW	5.2.8	\$ 4,761,763	\$ 5,296,255	\$ 4,930,948	\$ 365,307	\$ 4,930,948	\$ -
MECHAN	5.2.9	\$ -	\$ 5,147,681	\$ 4,949,690	\$ 197,991	\$ 4,025,049	\$ 924,641
	5.3	\$ 6,711,316	\$ 8,854,794	\$ 8,726,170	\$ 128,624	\$ 7,649,310	\$ 1,076,860
BUS MGM	5.3.1	\$ 989,280	\$ 1,203,787	\$ 1,202,710	\$ 1,077	\$ 1,202,710	\$ -
I&T	5.3.2	\$ 1,515,796	\$ 3,419,859	\$ 3,410,905	\$ 8,954	\$ 2,608,449	\$ 802,456
EAGE	5.3.3	\$ 1,861,349	\$ 1,795,940	\$ 1,723,919	\$ 72,021	\$ 1,723,919	\$ -
MAGE	5.3.4	\$ 201,757	\$ 273,846	\$ 273,846	\$ -	\$ 194,776	\$ 79,070
GND SW	5.3.5	\$ 2,143,134	\$ 2,161,362	\$ 2,114,790	\$ 46,572	\$ 1,919,456	\$ 195,334
TOTAL	5.0	\$ 39,515,491	\$ 55,891,559	\$ 53,138,751	\$ 2,752,808	\$ 45,821,872	\$ 7,316,879



NRL Escalation Rates (Budget)

	FY00	FY01	FY02	FY03	FY04	FY05	FY06	FY07
Inflation Rate		6.3%	7.8%	6.3%	6.3%	6.3%	6.3%	6.3%
Multiplier	1.000	1.063	1.146	1.218	1.295	1.376	1.463	1.555

FY01 Actual
FY02 Proposed
FY03-FY07 Estimate

FY99-02 Average (GS-14) 5.6%



5.1 - Bus Management

- **\$1,234K**
- **Basis of Estimate -**
 - **S/C Bus Management**
 - **S/C Bus Systems Engineering**
 - **Configuration Support**
 - **Scheduling**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 232K**



5.2.1 ADCS

- **\$4,698K**
- **Basis of Estimate -**
 - **ADCS Design, Analysis & Modeling - Requirements Analysis, Precession, ANC, SAP, AKM, Safe Hold, etc**
 - **Hardware Selection & Procurement**
 - **Star Trackers, IMUs, Torque Rods, Magnetometers, Sun Sensors**
 - **ADCS System Integration**
 - **I&T Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 287K**
 - **Two Month reduction in Development - 246K**



5.2.2 RCS

- **\$4,236K**
- **Basis of Estimate**
 - **RCS Design & Analysis**
 - **Hardware Selection & Procurement**
 - **Solid Rocket Motor, Propellant Tank, Thrusters, Transducers, Gases**
 - **RCS System Integration**
 - **I&T Support**
 - **Field Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 273K**
 - **AKM Savings - 1M**
 - **Thruster Quantity Reduction - 120K**
 - **Propellant Tank -Off the shelf design - 430K**



5.2.3 EPOS

- **\$5,984K**
- **Basis of Estimate**
 - **EPOS System Design, Fabrication, Test & Analysis**
 - **Charge Control, Load Distribution, Motor Control, Ordnance Control, Harness**
 - **Hardware Selection & Procurement (List Hardware)**
 - **Solar Arrays, Battery Cells, EEE Hardware, Harness Materials,**
 - **EPOS System Integration**
 - **I&T Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 444K**
 - **Reduction in Array Power Requirements - 353K**
 - **Battery Size - 288K**
 - **Re-Use of ICM Designs/Hardware - 611K**



5.2.4 CT&DH

- **\$4,979K**
- **Basis of Estimate**
 - **CT&DH System Design, Fabrication, Test & Analysis**
 - **Command/Telemetry Processing, ACS Processing, Instrument Interface (Command/Data Collection)**
 - **Hardware Selection & Procurement (List Hardware)**
 - **Processors, EEE Parts**
 - **CT&DH Subsystem Integration**
 - **I&T Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction -195K**
 - **Transfer of Remote Interface Unit from ICM Program - 575K**



5.2.5 - Structures

- **\$2,989K**
- **Basis of Estimate**
 - **Primary and Secondary Structure Design**
 - **Analysis (Classical and Finite Element Analysis)**
 - **RCS Layout/Design (Plumbing Layout/Bracketry design, etc)**
 - **Misc. Brackets (RF brackets, etc)**
 - **Assembly Drawings**
 - **I & T Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 231K**
 - **Labor Reduction - 609K**
 - **Composite Designer Eliminated**
 - **Design Labor Reduction**



5.2.6 - Thermal

- **\$1,652K**
- **Basis of Estimate**
 - **Thermal Design & Analysis**
 - **Hardware Selection & Procurement**
 - **Heaters, Thermostats, Thermistors, Blankets, Coatings, etc.**
 - **Fabrication**
 - **System Integration**
 - **I&T Support (TVDT, TVAC)**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 167K**
 - **Smaller Thermal System - 513K**
 - **Labor Reduction**
 - **Materials Reduction**



5.2.7 RF

- **\$3,443K**
- **Basis of Estimate**
 - **RF System Design, Fabrication, Test & Analysis**
 - **STDN Compatible RF System**
 - **Hardware Selection & Procurement**
 - **Transponders, Cables, Switches, etc.**
 - **RF Subsystem Integration & Test**
 - **I&T Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 232K**
 - **Elimination of Solid State Power Amplifier - 448K**



5.2.8 Flight SW

- **\$4,931K**
- **Basis of Estimate**
 - **Flight SW System Design, Coding, Test & Analysis**
 - **CMD/TLM Processing, GNC, Instrument Tasking/Telemetry**
 - **Material Selection & Procurement (List Hardware)**
 - **Development System**
 - **Flight Software Integration**
 - **I&T Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 365K**



5.2.9 Mechanisms

- **\$4,025K**
- **Basis of Estimate**
 - **Mechanisms Design & Analysis (Including Drawings)**
 - **Marmon Clamp, Trim Mass, Trim Area, Trim Tabs, Star Tracker Cover, Trim Area/Tab Release**
 - **Hardware Selection & Procurement**
 - **Motors, Springs, Ordnance, Paraffin Actuators, Pin Pullers**
 - **Subsystem Fabrication, Test, Integration & Qualification**
 - **I&T Support**
 - **Field Support**
 - **On-Orbit Support**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 198K**
 - **Elimination of Deployable Solar Array Sun Shield - 925K**



5.3.1 Bus Mgmt

- **\$1,203K**
- **Basis of Estimate**
 - **Labor support for Mechanical and Electrical Lead Engineers**
 - **Labor support for additional systems engineering**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 1K**



5.3.2 Bus I&T

- **\$2,608K**
- **Basis of Estimate**
 - **Material Procurement (Honeycomb, Aluminum Plate, etc)**
 - **Mechanical Part Fabrication and Assembly of Primary and Secondary Structure**
 - **Assembly & Integration of Subsystems With Bus Structure**
 - **Component Mechanical Testing (Vibe/Thermal Vac)**
 - **Engineering Model Fabrication and Testing**
 - **Wire Harness Mock-up**
 - **Contamination Control (S/C Bus)**
 - **MAGE/Test Fixture Fabrication**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 9K**
 - **Elimination of Composites/ Reduction in Piece Parts - 598K**
 - **Reduced Labor for System Fabrication - 204K**



5.3.3 EAGE

- **\$1,724K**
- **Basis of Estimate**
 - **Electrical Test System Design, Assembly, & Test**
 - **Spacecraft Controller Test Set**
 - **Software Test Bed Hardware**
 - **EAGE (S/C Electrical Test Equipment)**
 - **Launch Support Equipment**
 - **Material Selection & Procurement**
 - **Solar Array Simulator, VME Equipment, Test HW**
 - **I&T Support (Including Launch Site)**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 72K Labor**



5.3.4 MAGE

- **\$195K**
- **Basis of Estimate**
 - **Design and Analysis of Assembly and Test Fixtures**
 - **Design and Analysis of Lift/Handling fixtures**
 - **Design of Protective Covers**
 - **Transportation Container modifications**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 0K**
 - **Design Labor Reduction - 79K**



5.3.5 Ground Software

- **\$1,919K**
- **Basis of Estimate**
 - **Ground Software System Design, Coding, & Test**
 - **Equipment Control, CMD/TLM Processing, Automated Testing, Database Control**
 - **Support to EAGE Integration**
 - **I&T Support (Including Launch Site)**
- **Cost Savings from Jun-01 Baseline**
 - **8 Month Schedule Reduction - 46K Labor**
 - **Removal of OS-Comet 4.0; use BP Comet - 195K**



Other Possible Reductions (1 of 2)

- **Star Tracker Cover - Approx. 500K**
 - **Risk: Determine if Contamination is issue with current Design**
- **Active ACS Control - Approx. 1.5M**
 - **Add Reaction Wheels (Add 1M)**
 - **Remove Trim Areas, Trim Tabs, Trim Masses (Subtract 2.5M)**
 - **Risk: Unknown Data Analysis/Pipeline Risk**
- **Remove Trim Area and Trim Masses - Approx. 1M**
 - **Balance On Ground, Use Torque Rods as Backup**
 - **Risk: Evaluate Impact of Active ACS control with Torque Rods**
- **Re-Use Flight ACS Hardware from ICM (Not flight Spare HW) - 430K**
 - **IMU's, Sun Sensor, Magnetometer**
 - **Risk: Availability of Flight ICM hardware for Use on FAME**



Other Possible Reductions (2 of 2)

- **Eliminate Redundant Flight Hardware (Single String System)**
 - ACS - 930K
 - CT&DH - 800K (est.)
 - RF - 550K (est.)
 - Risk: Single String System not compatible with 5 year mission.
- **Eliminate Engineering Model Structure - 400K**
 - Risk: Delays testing; Adds risk later in program (Schedule and Technical)
- **Smaller Launch Vehicle, Eliminate AKM and third stage of LV - Replace with Bi-Prop, -[TBD K]**
 - Risk: Smaller Mass Margins on LV
- **HEO Orbit - Smaller LV, Eliminate AKM - [TBD Savings]**
 - Risk: Data Reduction/Radiation Effects/Ground System/Link Margin